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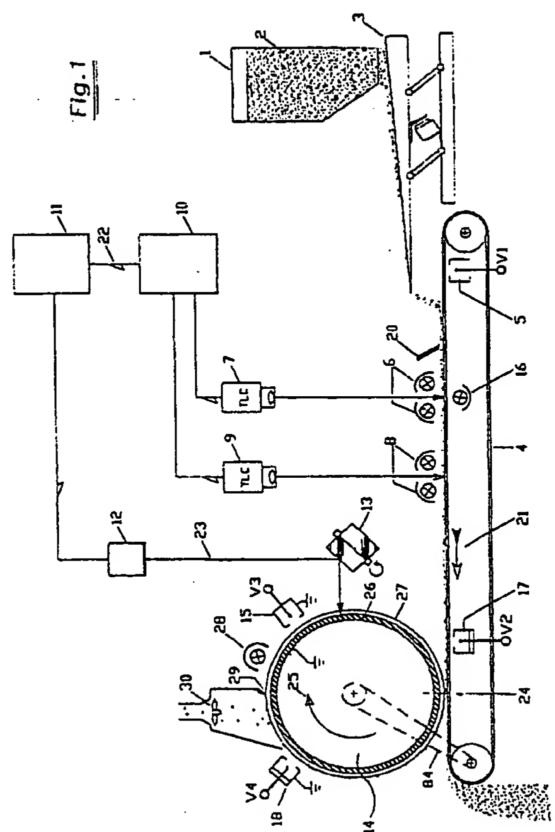
(54) **Selection equipment for powders and fine particulate material**

(57) A selection machine for fine particulate material such as, for example, semolina wheat or other food or industrial products in powdery or a granular form, where the particulate material is distributed on a continuous mobile support (4), is transported from the support to a scanning station (6, 7, 8, 9) for the identification in the particulate material, of undesirable parts thereof, and their position on the support, and, subsequently, to a sorting station (24) having a photoconducting element (27) that can be moved in synchronism with the support (4) and on which photoconducting element is formed a latent image of electrostatic charges, corresponding to the position of the undesirable parts, which photoconducting element separates the undesirable parts from the particulate material by electrostatic attraction.

Fig.1



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Description

The present invention relates to an equipment for selecting and separating desired fine particulate material in food or industrial material and, generically, powders.

Examples of fine particulate material include: semolina of wheat and of rice, or coffee or chocolate or other materials in the food field; the solid pigments used in the varnish and powders industry for sintered products, in the industrial field; and chemical components in powder form, in the pharmaceutical field.

To sort particulate material having certain dimensions, one uses, as is known, optical survey systems that scan the particulate material which is distributed on a mobile bed and that, after identifying, in the particulate material, an undesirable portion of a particular position, control mobile aspiration systems, made up of a plurality of vacuum nozzles, which are operated selectively to remove the undesirable portion.

A system of this type is described, for example, in the US patent No. 4,186,836.

Alternatively, the particulate material is made to flow, in a freefall, through an optical scanning station that selectively controls the blowing nozzles that are arranged downstream from the scanning station.

These selection techniques, whether blowing or aspiration, cannot be used for fine particulate material for various reasons: because the particles are so light, it is impossible to determine which are the undesirable parts, in a freefall and to remove them by blowing or aspiration. The small dimensions of the particles also restrict the output of the selection process and, with mechanical and pneumatic means, it is impossible to isolate the individual particle that is to be separated from the contiguous or nearby particles.

To sort fine granular material and powders, the sorting systems currently used are based on certain predetermined physical characteristics that differentiate the undesirable parts from others, without identification of the individual undesirable part.

For example, screening makes it possible to select particles that have different dimensions, as does flotation; centrifugation makes it possible to select particles that have differing specific weights; magnetic separation makes it possible to select particulate material as a function of its magnetic permeability, etc. In the food industry, and in the industry in general there are, however, many cases where these techniques are inadequate because the differentiation between the good product and the product to be discarded can be based only on the identification of generally optical properties, on the spatial identification of the parts to be discarded, and the removal of the product to be discarded requires the use of a local-action device, independent of any differences in a physical characteristic of the product to be discarded. There is, therefore, an unsatisfied need to overcome the intrinsic limitations of selection systems by means of spatial identification of the product to be discarded and local removal of the latter, using mechanical devices such as pneumatic blowers or aspiration devices, which when used for the selection of fine particulate material, can lead to unacceptable yields and very low productivity.

The selection equipment for powders and fine particulate material according to the present invention meets these requirements and solves these serious technical problems. Using this machine, the selective and local removal of undesirable parts is brought about by the forces of electrostatic attraction that are generated upon the particulate material, by means of electrical polarisation of said particulate material by the local electrical field, developed by electrical charges formed selectively on the surface of a load-carrying element, facing a mobile bed to support the material to be sorted and synchronised with the element that carries the electrical charges.

The selection process may, in some ways, be considered to be similar to the process used in electrophotographic printers. The material to be sorted is spread out uniformly on a mobile support, similar to the developer roller of an electrophotographic printer, and is scanned by suitable means, which are themselves known and which determine the presence, on the support, of undesirable parts, as well as their position. In the course of its movement, the support is juxtaposed to a latent image carrier, consisting, for example, of a cylinder with a surface made of photoconducting material.

The latent image consists of electrical charges, arranged according to a representative configuration, in a positive or negative form, of the position of the undesirable parts and is formed by processes well known in the field of electrophotographic printing.

If the image is a positive latent image, the undesirable parts of the particulate material, which are juxtaposed to the latent image carrier, are attracted to the surface of the latent image carrier and are removed from the mobile support. If the latent image is a negative latent image, it is the particulate material, devoid of undesirable parts, that is attracted to the surface of the latent image carrier.

The material that is attracted to the surface of the latent image carrier is then separated from the former by means, for example, of a cleaning blade, a rotating brush, and/or blowing/aspirating systems.

A selection machine of this type can sort even extremely fine particulate material at great speed, with a very high selection output, correlated to the very high resolution (as much as 600 dpi) with which the latent image can be formed.

In practice, since the resolution of the process, on the one hand, and the velocity of the process (and hence, the productivity of the process), on the other hand, are somewhat antithetical terms, it may be convenient, in some cases, to reduce the resolution of the

latent image to the detriment of the selection performance and to the benefit of the productivity.

According to a further embodiment of the present invention, an equipment of the type described performs a sorting of particulate material by means of discarding the undesired parts fractioned into classes.

In this embodiment, scanning means are provided which, in addition to recognising the presence of undesirable parts and their spatial position on the mobile support, identify the membership of the various undesirable parts in one of the plurality of classes.

Depending on the membership of the undesirable parts in the various classes, there is generated, on a plurality of latent image carriers, a plurality of latent images, one per carrier, each correlated to a certain class of undesirable parts.

In this way, it is possible to remove separately the various classes of undesirable parts from the particulate material with a "differentiated collection", facilitating the possible re-use or recycling of the discards for various applications.

The characteristics and advantages of the present invention will better emerge from the detailed description that follows made with reference to the accompanying drawings which represent a preferred embodiment and its variants wherein:

- Figure 1 is an overall schematic view showing a preferred embodiment of the sorting machinery;
- Figure 2 is an overall schematic view showing a first embodiment variant of the machinery in figure 1;
- Figure 3 is an overall schematic view showing a preferred embodiment of the sorting machinery according to the present invention, capable of performing a sorting operation for distinct or separate classes;
- Figure 4 is an overall schematic view showing a second embodiment variant of the machinery shown in figure 1.

With reference to fig. 1, a preferred embodiment of the selection machine for powders according to the present invention comprises a hopper containing powder to be sorted 2, which is deposited by discharging the hopper, in a monitored quantity upon a vibrating surface 3 that provides for the uniform distribution of the product.

The vibrating surface deposits the powder on the upper face of an endless conveyor belt 4 that runs at the correct speed, for example, 1 to 2 metres per second, indicated by arrow 21.

Where necessary, a scraping knife 20 forms a single layer of granules on belt 4. Although the conveyor belt is shown as being horizontal, it can also be inclined.

If the weight of the material and the possible surface roughness of the conveyor belt are not sufficient to ensure the stability of the material in position on the belt, provision can be made, as illustrated, for an electrostatic load generator or corotron 5 that forms a uniformly distributed charge on the lower face of the belt, immediately upstream from the scraping knife 20. In this case, the belt 4 is suitably thin and made of insulating material, with a low dielectric constant, so that the electrical fields generated by the deposited charge, will effectively attract powders 2 on the belt surface, stabilising the powder in position. Corotron 5 is supplied with a suitable voltage V1, for example, -2KV, with relation to the mass, to raise the lower face of the belt to a suitable potential, for example, -300 Volts, and that is a function of the material to be treated. It is obvious that corotron 5 can be replaced by a conducting rubber roller or by a metal brush which, in this case, are supplied with a suitable voltage to achieve the same effect.

It may be necessary to monitor and regulate the voltage supply to corotron 5 and/or also to the other corotrons used in process (15, 17, 18) according to the humidity percentage present in the product to be sorted.

The formation of the charge on the lower face of the conveyor belt may be facilitated by an anodic field plate, connected to the ground and facing the transportation surface, opposite corotron 5, or the roller or brush.

Scraping knife 20, corotron 5, and the discharge edge of vibrating surface 3 define a loading station which conveyor belt 4 passes during its continuous movement.

From the loading station, the particulate material which is distributed uniformly over the conveyor belt, is transported to a scanning or reading station where a reading system, which may be of a known type, identifies possible defects in the particulate material and, hence, undesirable parts 90 of the product.

The reading system comprises an illuminating group 6 that illuminates a transverse section of the conveyor belt with a light having a predetermined frequency or a combination of predetermined frequencies, and a remote camera 7 or a solid-state sensor that acquires the image of the moving product in the simplest case, merely by means of the rows running transverse to the forward direction of the conveyor belt.

The acquisition of the image is synchronised with the movement of the conveyor belt; in other words, the image of each row is correlated with the position of the row on the conveyor belt so that it is possible to know the position of the same row at any successive instant as a function of the running speed of the conveyor belt.

For special types of powders to be sorted 2, it is possible to introduce, inside conveyor belt 4, an illuminating source 16, having characteristics similar to those of illuminating group 6, to increase the contrast of the undesirable parts 90. Provision may be made, as shown in figure 1, although it is not necessary, for a multiple reading system, comprising a second illuminating group 8 with a wavelength different from that of the first one and a second remote camera. This is done to spot different defects that are evidenced only under particular and distinct illumination conditions.

It is clear, however, that the same effect could be

achieved by using wide-spectrum light and filters associated with several remote cameras. The signals from remote cameras 7 and 9 are sent to a processing unit 10, of a conventional type that is available on the market, which through suitable processing algorithms, identifies all of the granules of the particulate material which, by virtue of dimension and/or colour and/or shape and/or reflectivity, do not correspond to the desired product and must be discarded.

At its output, on a channel 22, the processing unit generates properly timed command signals that are representative of the spatial position, on the conveyor belt, of the defective parts that are to be discarded.

These signals, suitably amplified, in the known state of the art, control electromechanical and electropneumatic devices for the aspiration extraction of defective parts to be discarded.

According to the present invention, the output signals coming from the processing unit 10 are applied to an electronic modulation logic unit 11, of the type commonly used in electrophotographic printers, more commonly known as laser printers.

Unit 11 controls a laser diode 12, preferably with a modulation device of ON-OFF type, whose light beam 23, correctly collimated, is deflected by a rotating mirror 13 towards the surface of a mobile element 14, generally having the shape of a rotating drum, or other reflection systems, which, by virtue of the function it performs, is called a latent image carrier or a photoconducting roller in electrophotographic technology.

Mirror 13 (which is in fact, a rotating prism with several mirror rollers) deflects light beam 23 along a generatrix of the rotating drum, so that, due to the combined effect of scanning light beam 23 and the rotation of drum 14, the entire cylindrical surface of said drum 14 will be scanned.

Replacing the laser diode 12 and the mirror 13, it is well known that one can use a row of matrix of photoemitting diodes, controlled individually (LED ARRAY), arranged along a generatrix of said drum 14.

Said drum 14 is positioned, in relation to said conveyor belt 4 that carries the particulate material, in such a way that one of its generatrixes, pertaining to the sorting station 24, will be faced in close proximity by said conveyor belt 4, at a distance which, according to the grain size of the particulate material, can very from several tenths of a micron to several millimetres.

The drum 14 is mechanically coupled to the conveyor belt 4 activating device by a mechanical transmission 84, so that the drum will rotate in the direction indicated by arrow 25, at a peripheral speed that is exactly equal to the forward movement speed of the conveyor belt 4. It is thus evident that, unambiguously, one point and only one point on the surface of the drum corresponds to every point on the upper surface of the conveyor belt and that these points are juxtaposed in correspondence to the generatrix of the sorting station 24.

Along the passageway of said conveyor belt 4, the generatrix of sorting station 24 defines a position which, in electrophotographic printing technology, is called a developing station, which, in this application, can be called a sorting station.

The drum 14 consists of a conducting cylindrical element 26, generally made of metal, picked at a predetermined (generally ground) potential, on whose outer surface is formed a photoconducting layer 27.

The following are arranged, along the periphery of the drum, in inverse order with respect to its direction of rotation and up-line from the generatrix that is scanned by light beam 23:

a crown-effect electrostatic charge generator or corotron 15, supplied with a voltage V3 (for example, - 2KV) which uniformly charges the surface of the photoconductor at a predetermined potential, for example - 700V;
a normalising (quenching) lamp 28 that, by activating the photoconductor, discharges it, thus bringing it to a potential that is very close to the potential of conductor 26 - in other words, the ground potential;
scraping and cleaning knife 29 of the drum, associated with an aspirating hood 30;
an optional electrostatic charge generator or corotron 18, supplied with a voltage V4, having a sign opposite to V3, in order to at least partly neutralise any residual electrical charge present on the photoconductor, thereby facilitating the separation of the particulate material present there.

When a corotron 5 is employed to stabilise the solid particulate material distributed over conveyor belt 4, the equipment also contains another electrostatic charge generator or corotron 17, in proximity to sorting station 24, supplied with a voltage V2, to at least partly neutralise the electrical charge that is applied to conveyor belt 4 and to promote the removal of the solid particulate material from conveyor belt 4.

The embodiment of the equipment thus described works in a very simple manner.

As the solid particulate material, transported by conveyor belt 4, gradually passes through the scanning station, the spatial position of the identified defects on the conveyor belt, determined as a co-ordinate on a line transverse to the direction of the travel of the belt, is stored by processing unit 10. The processing unit, after a suitable delay (which is determined by the difference between the time necessary for the scanned conveyor to pass from the scanning station to sorting station 24 and the time necessary for the generatrix of drum 14, scanned by the light scanning beam, to reach the sorting station) quenches the light scanning beam, corresponding to the position of the defects.

Downstream from the generatrix of drum 14, which scanned by beam 23, there is thus formed a latent positive image that is representative of the defects and that is made up of electrical charges, arranged on photosen-

sitive surface 27, at the points corresponding to the spatial position of the defects of the particulate material on the conveyor belt.

When the particulate material arrives at sorting station 24, the defective and undesirable part is attracted electrostatically by the electrical field that is locally generated by the electrical charges of the latent image, and is removed from the conveyor belt 4 to adhere to the surface of drum 14.

Purified of undesirable parts 90, the particulate material proceeds along conveyor belt 4 so as to be discharged, also nearly by the effect of gravity, into a suitable collector.

Undesirable parts 90, transported by drum 14, appear, if present, under corotron 18, which neutralises the residual electrostatic charges, and proceed all the way to aspiration hood 30, where scraping knife 29 removes them from the surface of the drum to permit their aspiration. The subsequent quenching lamp 28 ensures the suppression of any residual charge of the photosensitive layer to present it again at the loading station formed by corotron 15, under predetermined conditions, so as to permit the continuous repetition of the process.

It is clear that the sorting process can be based not only on the formation of a latent image of the positive type (where the electrical charge, left on the photoconducting material, represents the defects), but also on the formation of the latent image of the negative type, in which the electrical charge, left on the photoconducting material, represents the particulate material that is devoid of any defects and where the defects are represented by the absence of a charge.

In this case the undesirable parts 90 are left on conveyor belt 4 at the sorting station and they are discharged from said conveyor belt while the particulate material, that has been deprived of any defects, is "captured" by drum 14 and adheres thereto. The first alternative is preferable for some uses, as will be discussed later.

It is thus evident that the sorting process used here is very similar to an electrophotographic printing process and, also similarly, can benefit from many of the technical devices and multiple process and structural implementation variants that have been developed for electrophotographic printing, so as to adapt the equipment to specific sorting and separation requirements, dictated by the various materials to be sorted.

Some of these variants are shown below.

Figure 2 shows an embodiment of the sorting machine where all the crown-effect electrostatic discharges or corotrons, which to some extent generate ozone, are completely eliminated and replaced by non-ionizing electrostatic charge generators. Because the machine in Figure 2 differs from that in Figure 1 only in some respects, functional elements equivalent to those in Figure 1 are identified by the same reference numbers, and any detailed description of the machinery and its operation, that are substantially identical to those in Figure 1, is omitted.

In Figure 2, the corotron 5, from Figure 1, is replaced by a conducting rubber roller 32, which is located opposite a grounded field armature 33. The roller is polarised by a voltage source V6 for applying an electrical charge to conveyor belt 4. The electrical charge, formed on conveyor belt 4, is discharged at the sorting station by a conductor roller 34 which is grounded, and which, in a suitable manner, acts as a moving roller for conveyor belt 4.

Corotron 15, in Figure 1, is replaced in Figure 2 by a conducting rubber roller 31, which is polarised by a voltage V5.

Finally, by using a cylindrical conducting element 74 made of transparent or translucent conducting material by substituting a metallic cylindrical element, quenching lamp 28 can be housed inside the drum corresponding to the aspiration hood 30, and can perform both the function of quenching the photoconducting layer 27 and the function of charge neutralisation performed by corotron 18 in Figure 1. To permit the selective sorting of undesirable parts 90, which are grouped in different defect classes, one may use a plurality of removal means - in other words, complexes, such as drum 14, laser diode 12, and modulation unit 11, as shown in Figure 1.

An equipment that meets this requirements is shown in Figure 3; two distinct reading systems, 6, 7 and 8, 9, send reading signals to two distinct processing units 10, 35, which, in turn, control two distinct modulation units, 11, 36, each made up of a laser diode 12, 37.

By means of a deflecting mirror 13, 38, each of the laser diodes forms a latent image on photosensitive surface layers 27, 87, respectively, of each of the two drums 14, 46 that carry latent images, which together with conveyor belt 4, define two distinct and methodically successive sorting stations.

In this case, the latent image, formed on drum 14, is necessarily of the positive type and identifies the position of a first class of defects.

The latent image on drum 46, of either the positive or negative type, identifies a second class of defects in position.

In this way, the drum 14 picks up and removes a first class of undesirable parts 90 and drum 46 separates a second class of undesirable parts 90 from the particulate material.

It is obvious that the differentiation operation between the two classes of defects can also be performed, in many practical applications, by a single processing unit that controls a plurality of optical modulation units, and that, in the situation, one reading system alone may suffice. Also in this example the two drums 14, 46 are mechanically connected to the conveyor belt 4 by a mechanical transmission 84, 85. The latter can be replaced by an electronic movement synchronisation systems.

The other variants shown in Figure 3 are examples of the wide range of technical solutions offered by the machinery.

To stabilise - whenever necessary - the product on conveyor belt 4, one may use a double grid 40 of interlaced electrodes, among which is applied a suitable voltage V7.

Where a thin dielectric layer is interposed, the electrodes are arranged so as to face toward the lower side of the conveyor belt 4, along the entire run from the loading station up to the last sorting station, with the exception of the intermediate sorting station.

On the upper face of the conveyor belt, these electrodes generate a spatially alternating electrical field that exerts a pulsating electrostatic attraction force (by way of electrical polarisation) upon the solid particulate material.

The electrostatic charge generators on the photosensitive surface of drums 14, 46 may be either conducting rubber rollers 41, electrically polarised by an applied voltage V8, or may be rotating brushes 42, which are electrically polarised by an applied voltage V9.

The quenching lamp 43 may be inside the drum 14 if the latter is transparent or it may be outside if the latter is opaque. Moreover, if the drum 46 is opaque, the quenching lamp 44 can also be inside an aspiration hood 45.

In the preceding examples, reference was always made to a continuous conveyor belt and to a cylindrical removal drum. But it is evident that the removal drum, or removal drums, can be replaced by an endless belt or belts made up of a conducting support that is possibly transparent and upon which a photoconducting layer is superimposed. By the same token, endless belt 4 can be replaced by a mobile supporting element for particulate material in a cylindrical shape.

Figure 4 shows a sorting equipment in which both mobile transport element 50 for particulate material and mobile removal element 51 are made up of two counter-rotating cylindrical drums. Both drums 50 and 51 are suitably made up of a transparent conducting support 53, 54 on which a photoconducting layer 55, 56 is superposed.

The two drums are juxtaposed at a suitable distance from each other, along a generatrix 57 that defines a sorting station, and are linked mechanically to the movement device of a mechanical transmission 84, so that the peripheral speeds of the two drums will be equal and synchronised.

The conducting support of the two drums is suitably polarised at a suitable potential - for example, a ground potential.

A brush 58 or some other equivalent means electrically charges the surface of drum 50, and a loading hopper 59 distributes, on the surface of drum 50, a uniform layer of particulate material that adheres to the surface of the drum. In the course of its rotation movement, drum 50 exposes the particulate material to a reading system 61 that is connected to a defect and modulation recognition unit 62 that controls a selective illumination system 63, 64 for a generatrix of drum 51 and for the formation of a latent image on its surface. During their passage to sorting station 57, undesirable parts 90 of the particulate material are attracted to the surface of drum 51 and are conveyed to a collecting chamber 65.

To facilitate the migration of the undesirable parts 90 from the drum 50 to drum 51 and from drum 51 to collecting chamber 65, there is provided, inside drum 50, a charge neutralisation and quenching lamp 66, immediately up-line from sorting station 57, and inside drum 51, there is a lamp 67 which has the same function.

Obviously, in machinery of this type, the reading system must operate in a spectral field to which the photoconducting material is insensitive, or at brightness levels that are insufficient to neutralise the charge formed on the photoconducting material, or the particulate material itself must, through its opacity, supply an adequate screen against radiation.

It is also clear that the latent image, formed on drum 51, can be negative, and that provision can be made for a third drum, arranged tandem to the second one, so as to form a second latent image on it with a suitable potential to track a distinct sorting operation for classes of defects.

In the above description, reference was made to the sole phenomenon of electrical and dielectrical polarisation of the particulate material, immersed in an electrical field, as causing the electrostatic forces exerted upon the particulate material. But it is evident that, in many practical applications, it is also possible, as in electrophotography, to induce an electrical charge directly upon the particulate material by the triboelectric effect, and to use the repulsion and attraction forces that are exerted among the electrical charges with an equal or opposite sign so as to obtain the selective attraction or repulsion of the particulate material from a suitably electrically polarised support toward another removal element on which a latent image is formed, consisting of selectively placed electrostatic charges.

Claims

1. An equipment for sorting particulate material and removing undesirable parts (90) therefrom, comprising:

   - a mobile support (4) for supporting the particulate material,
   - means (6, 7, 8, 9, 10) for determining the presence on the support (4) of undesirable parts (90) and their position on said support and for supplying indications of their position on said support, and
   - means controlled from said indications for removing said undesirable parts (90) from said particulate material characterised in that said removing means include:
   - a mobile element (14) synchronised with said

support (4) and having a photoconducting surface (27) and to every point of said surface corresponds a predetermined position on said support (4),

- means (15) for electrostatically charging the photoconducting surface (27) of the mobile element (14),
- means (11, 12, 13) for generating, on said photoconducting surface (27), in response to said indications of the presence of undesirable parts (90) and of their position, a latent image of electrostatic charges which is representative of said undesirable parts (90),
- means (84) for juxtaposing each of the points of said photoconducting surface to the corresponding position of said support (4) in such a way that the electrical field generated by the electrostatic charges of said latent image separates the undesirable parts (90) from the particulate material attracting onto said photosensitive surface said undesirable parts (90) if said latent image is of a positive type and said particulate material (2) deprived of undesirable parts (90) if said latent image is of a negative type, and
- means for removing (18, 29, 30) particulate material attracted onto said photosensitive surface (27) from said electrical charges of latent image.

2. An equipment for sorting particulate material and removing undesirable parts (90) therefrom, including:

- a mobile support (4) for particulate material,
- means for scanning the support (4) in order to determine the presence on said support of undesirable parts (90), their position on the support, and for providing indications about their presence and position on the support, and
- removing means controlled by said indications capable of removing said undesirable parts (90) from said support, characterised in what it comprises,
- means (6, 7, 8, 9, 10, 35) for determining whether said undesirable parts (90) belong to a class of a plurality of classes, and for supplying an indication of the class associated with said indication of position and by what said removing means include:
- a plurality of elements (14, 46) each of which is associated to one of said classes, synchronically mobile (84, 85) with said support (4) each of which has a photoconducting surface (27, 87), to each point of said surface corresponding a predetermined position on said support,
- means (41, 42) for charging electrostatically the photoconducting surface (27, 87) of the mobile elements (14, 46),
- means (11, 12, 13, 36, 37, 38) for generating, in response to said indications about the presence of undesirable parts (90), their position and their class, on said photoconducting surface (27, 87) of mobile elements (14, 46) each of which is associated with one of said classes, a latent image of electrostatic charges which is representative of the undesirable parts (90) of said associated class,
- means (84, 85) for juxtaposing each of said surface point of said mobile elements (14, 46) to the corresponding position of said support (4) in such a way that the electrical field generated by said electrostatic charges of latent image separates one class of undesirable parts (90) from said particulate material attracting onto said photoconducting surface (27, 87) said one class of undesirable parts (90) if the latent image is positive, and said particulate material, deprived of said one class of undesirable parts (90) if said latent image is negative, and
- means (29, 30, 45) for removing particulate material attracted onto said photoconducting surface from said photoconducting surface (27, 87).

3. An equipment as claimed in claim 1, characterised in that said mobile element is a rotating cylindrical drum (46), having a photoconducting layer (87) on its peripheral surface supported by an internal transparent conducting layer (74), and said drum (46) housing internally a fixed lamp (28) for neutralising the electrical field irradiating said photoconducting layer (87) through said transparent conducting layer (74), along a fixed generatrix of said drum.

4. An equipment as claimed in claim 2, characterised in that at least one of said mobile elements is a rotating cylindrical drum, having a photoconducting layer (87) on its peripheral surface supported by an internal transparent conducting layer, and said drum housing internally a fixed lamp (43) for neutralising the electrical field irradiating said photoconducting layer (87) through said transparent conducting layer, along a fixed generatrix of said drum.

5. An equipment as claimed in claims 1, 2, 3 or 4, characterised in that said mobile support (4) of particulate material extends along a predetermined path, comprising, in sequence, a loading station (3), a scanning station (6, 7, 8, 9), at least a sorting station (24) and a discharging station, said equipment comprising means (5) for generating an electrical field on the surface of said support (4) upstream from said scanning station (6, 7, 8, 9, 16) and means (17) for neutralising said electrical field to said at least

one sorting station (24).

6. An equipment as claimed in claims 1, 2, 3 or 4, characterised in that said mobile support of particulate material extends along a predetermined path comprising, in sequence, a loading station (59), a scanning station (60, 61), at least a sorting station (57) and a discharging station, said equipment comprising a rotating cylindrical support (50) having a photoconducting layer (55) on its peripheral surface, said layer being supported by an internal transparent conducting layer (53) and means (58) to generate an electrical field on the surface of said support (50) upstream from said loading station (59) and means (66) for neutralising said electrical field downstream from said scanning station (60, 61) and upstream from said sorting station (57).

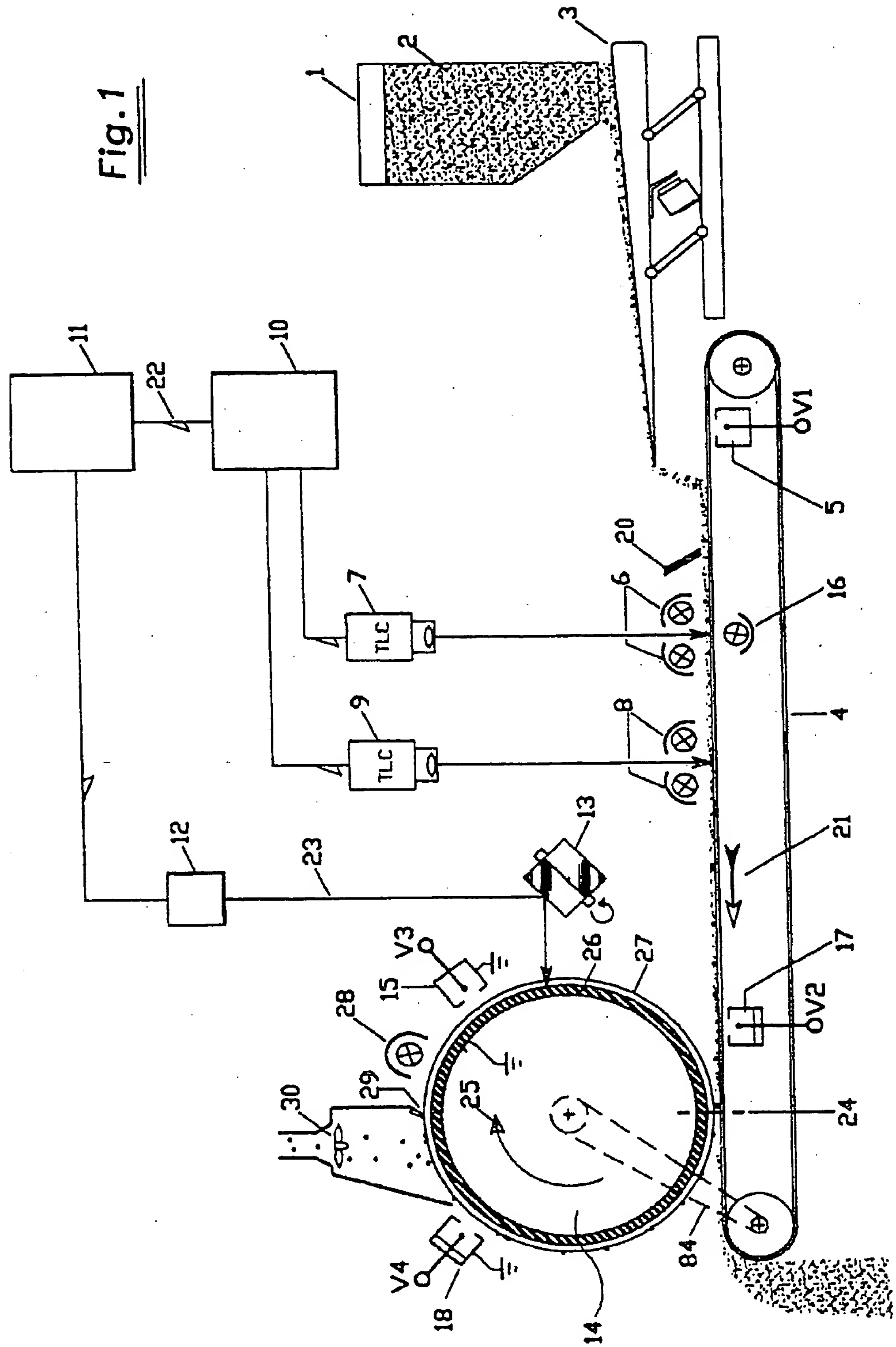

Fig.1

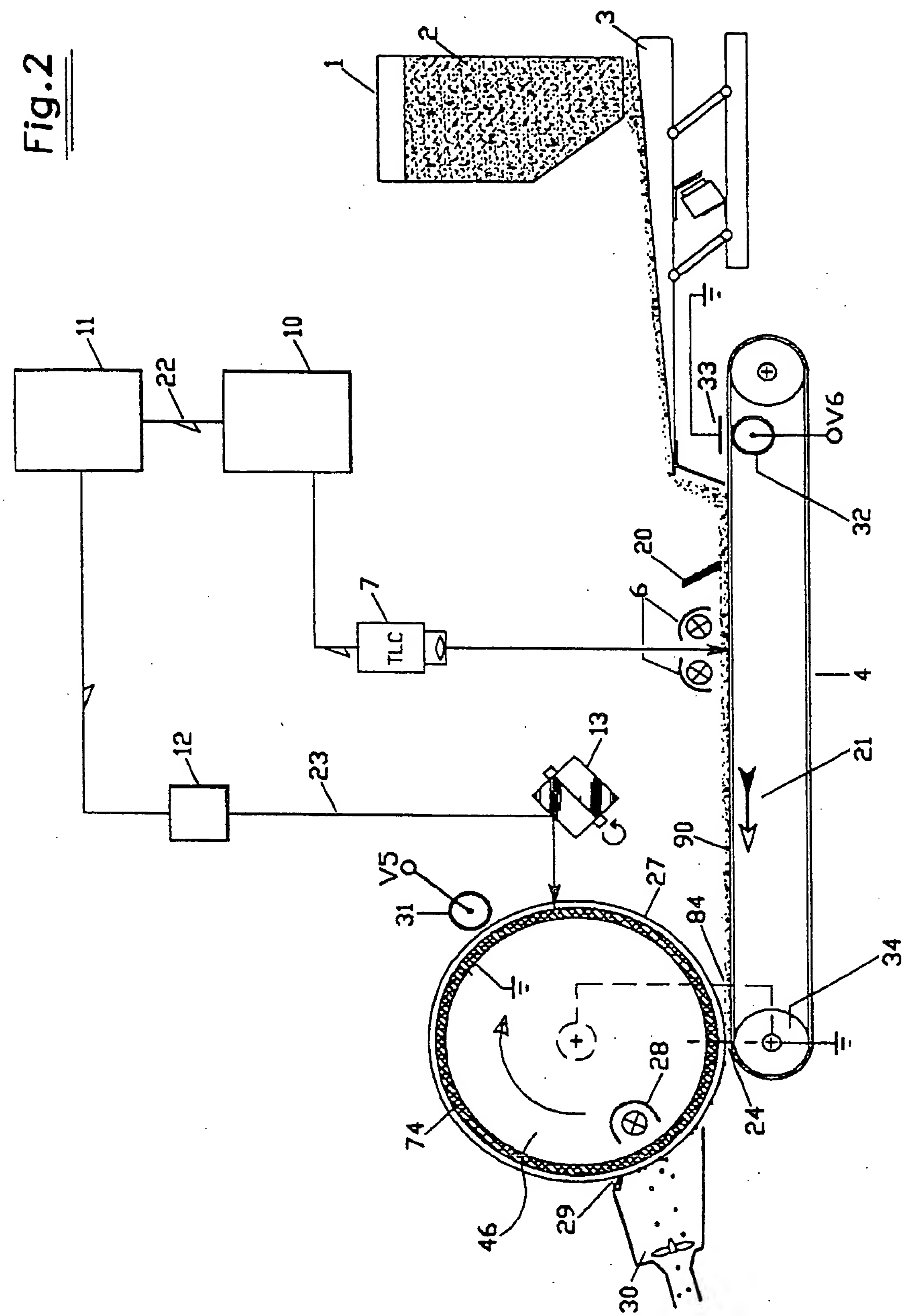
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Fig.2

Fig.3

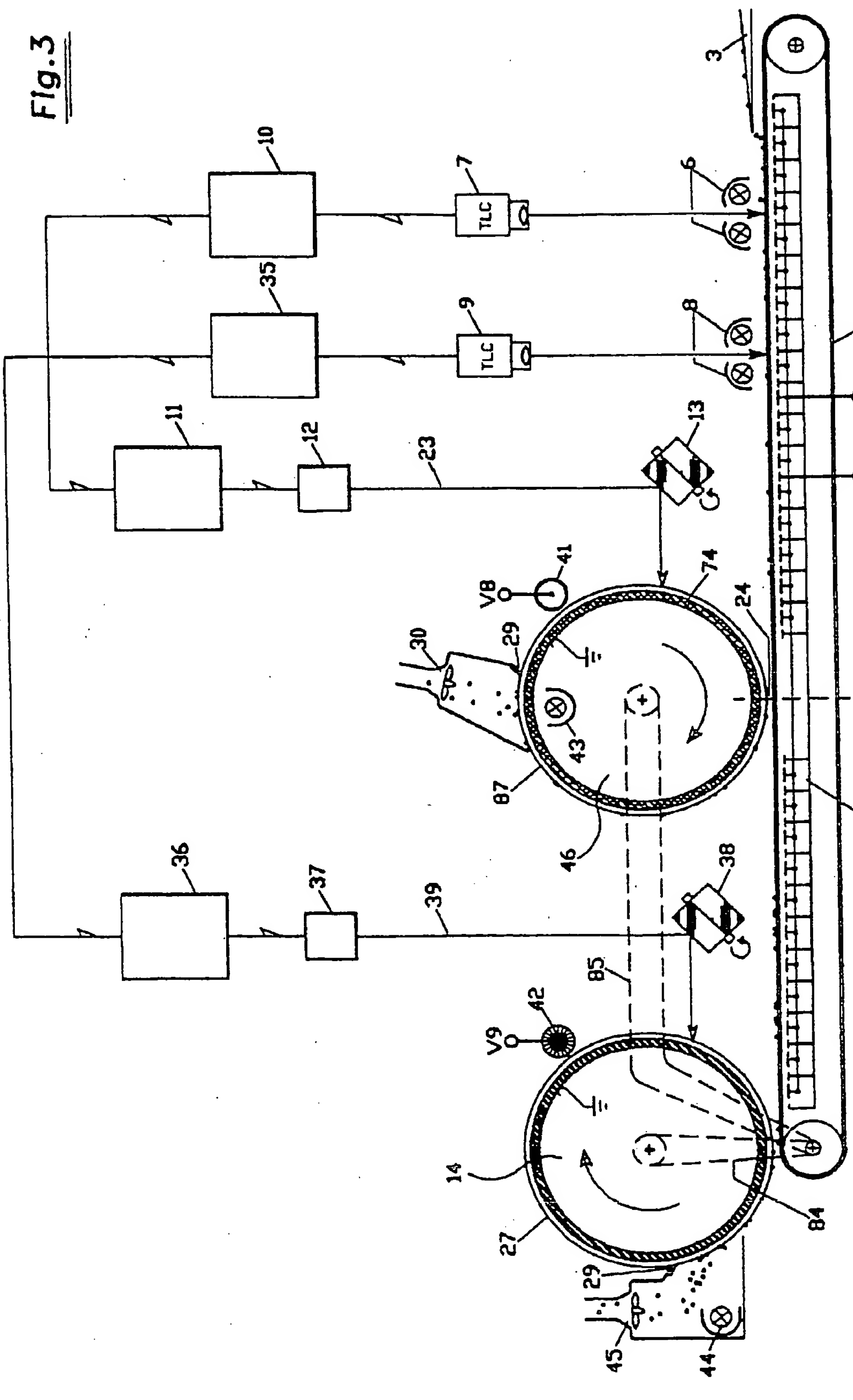
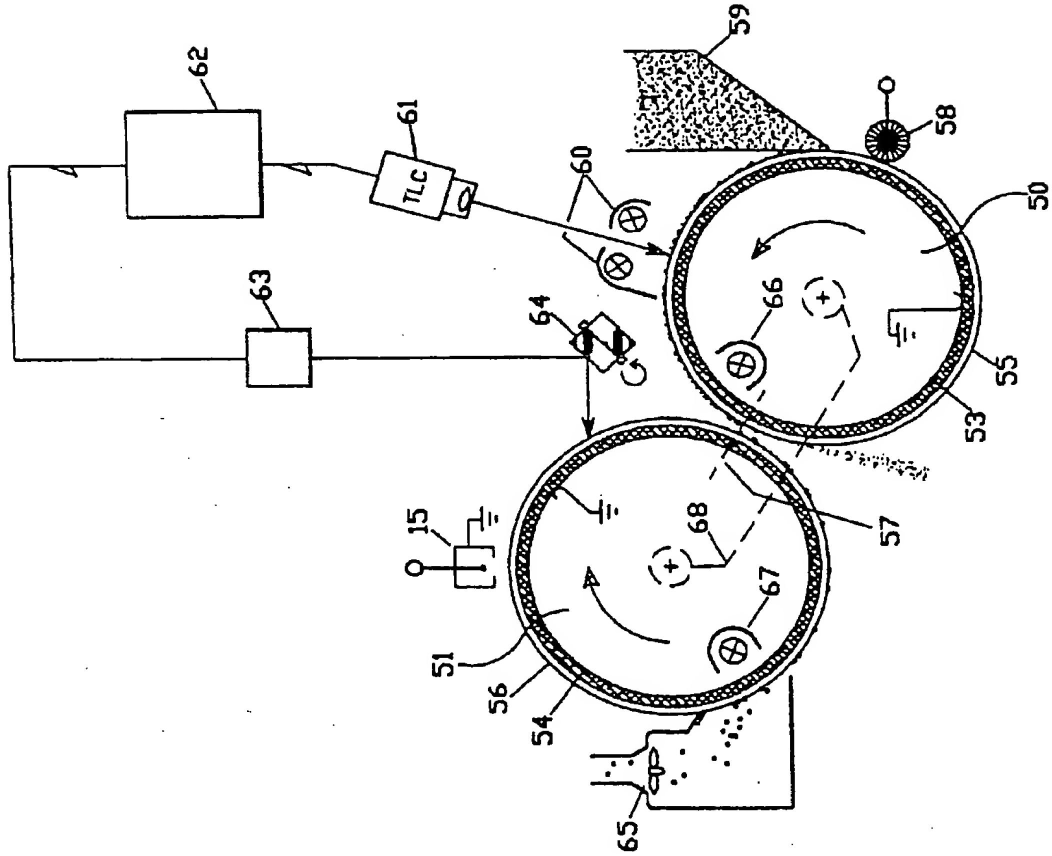


Fig.4



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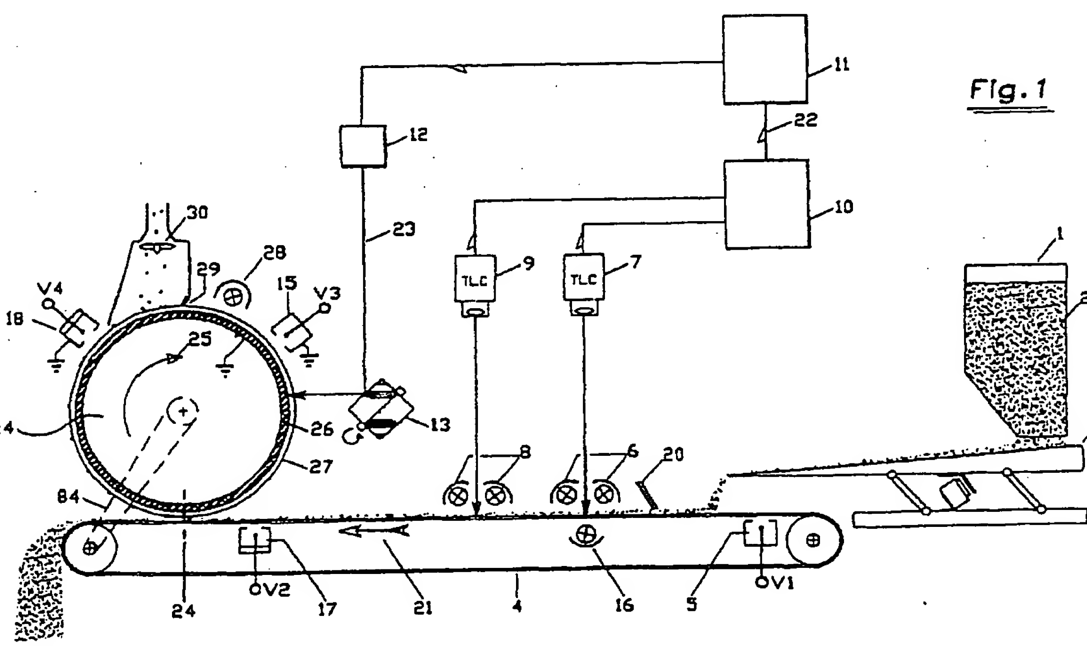
(54) **Selection equipment for powders and fine particulate material**

(57) A selection machine for fine particulate material such as, for example, semolina wheat or other food or industrial products in powdery or a granular form, where the particulate material is distributed on a continuous mobile support (4), is transported from the support to a scanning station (6, 7, 8, 9) for the identification in the particulate material, of undesirable parts thereof, and their position on the support, and, subsequently, to a sorting station (24) having a photoconducting element (27) that can be moved in synchronism with the support (4) and on which photoconducting element is formed a latent image of electrostatic charges, corresponding to the position of the undesirable parts, which photoconducting element separates the undesirable parts from the particulate material by electrostatic attraction.

Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0286

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 4 549 659 A (HAWKINS ET AL) 29 October 1985 * column 3, line 39 - column 6, line 30; figures 1,2 *	1,3	B07C5/36
A	US 3 977 526 A (GORDON ET AL) 31 August 1976		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B07C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 September 1998	Forlen, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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